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EFFECT OF MARRIAGE ON LIFE.

(*Continued from page* 18.)

IT will not be denied that many men are prevented from marrying by ill-health or a weakly constitution. This may happen in more ways than one. A man may either, through ill-health, suffer by comparison with the hearty and stalwart, or he may feel that he is unfit to struggle with other difficulties than those he has as a single man,—that he is unable, perhaps, to provide for wife and children, or that the cares and anxieties which married life necessarily brings with it would be more than he could bear. For instance, the very thought of a crying child disturbing his night's rest would shake the nerves of an invalid. Or again, if a man is consumptive, or suffers under any other ailment which is apt to repeat itself in successive generations, he may well and wisely eschew the thought of marriage, fearing lest he should become the parent of unhealthy children. In these and in many other ways, unhealthy or weakly-constitutioned men fall into the list of bachelors. No one can fail to recognise the influence of this form of "selection" on the comparative mortality of the two classes we are considering.

Again, it cannot be doubted that very indigent persons and the members of unhealthy trades are, on the whole, kept somewhat from the lists of marrying men. Of course, hundreds of these marry in any given country; but comparing them as classes with other classes, there is, undoubtedly, such a tendency as we have mentioned. The influence of this cause, again, cannot be doubted, since the longevity of the classes we have named is undoubtedly inferior to the average longevity of the population.

Here, then, we see two causes (and many others might be mentioned) tending to add to the lists of bachelors classes of men of inferior longevity. How great the influence to be assigned to such causes may be it is not easy to determine, but we cannot doubt that the influence is an important one. At any rate, it is impossible to estimate the value of results in which allowance has not been made for influencing causes of this sort. So long as there is any suspicion that the classes from which we make our estimates are not equally balanced, no confidence can be placed in those estimates.

In fact, it is by selection of this sort that "facts and figures" have been made to "prove anything." We might prove that to have a title conduces to longevity, because the average age to which noblemen live is above the average for the whole country. We might prove that to be a lawyer or to be a Quaker is the great "elixir vitæ," for similar reasons. The argument against such assertions as these is, of course, similar to that we have applied to Dr. Stark's reasoning. The death-rate of the nobility is lower because they are as a class richer than the average population of the country, and therefore have more comforts, less occasion for entering on dangerous or unhealthy occupations, and so on. And similarly with the other cases adduced.

We might establish the very reverse of Dr. Stark's conclusion if, instead of taking the whole population of bachelors, we were to compare the death-rate of married men with the death-rate of the Catholic priesthood, or of Fellows of Colleges. And we should be making an error differing only in degree, not in kind, from that which, we submit, Drs. Stark and Drysdale made. We should be taking a set of men from which many unfavourable classes are *eliminated*, just as he has taken a set into which an unduly large number from unfavourable classes have been *introduced*.

But we have said that we do not consider Dr. Stark's evidence to be wholly without weight. We think the preponderance of deaths among bachelors is somewhat greater than was to be expected from the preponderant presence, among bachelors, of persons from the classes we have spoken of. We think, however, that what is proved by this preponderance is little more than what might have been reasonably anticipated. It would be idle to point out the variety of ways in which the life of a married man, or of a widower, has an enhanced value, since every one recognises the fact. He must be indeed unfamiliar with human nature, who is not aware that the mere love of life is no all-sufficient check upon recklessness. The consideration that others will suffer by our death, that wife or children will be left desolate, is a restraint on many men, who would but for this freely expose their lives to danger. The mere fact that marriage brings with it home duties and domestic habits, is of itself an important influence for good. That hundreds of married men neglect those duties and do not fall into those habits is true enough; but the fact that large numbers *are* kept within the home-circle, cannot but have an important influence on the death-rate. In individual instances "bachelor habits" may not affect longevity, but in taking the average of a large number, the truth will appear of the old French proverb, "Où peut-on être mieux qu'au sein de sa famille?"

That the *whole* of the preponderance exhibited by Dr. Stark is not due to the considerations just discussed seems to us to be very strikingly shown by the distribution of that preponderance among the different ages. It appears to us that the influence of the more regular habits which belong to the married state would not be likely to show itself most strongly between the ages of twenty and twenty-five, but would rather appear with a gradually increasing effect in successive quinquennial periods. On the other hand, the influence of the causes which keep within the list of bachelors large classes of short-lived persons, would undoubtedly show itself most at the earlier ages. For of men so weakly as not to be likely to survive the age of twenty-five scarcely any would marry; men whose expectation of life was somewhat greater would be somewhat less likely to remain unmarried; and so on. In other words, the list of bachelors would be more largely recruited from classes tending to increase the death-rates for the *earlier* quinquennial periods than for the *latter*.

In fact, Drs. Stark and Drysdale in their method of

treating the statistics afforded by general registration neglected those rules to which M. Quetelet, in his work on probability, called the particular attention of statisticians. The laws of probability applied to statistics afford evidence of the highest value, when suitable care is taken to exclude all influences due to selection and therefore not falling fairly within the province of probabilities. But when attention is not paid to such considerations, it becomes impossible to say what absurdities may not be proved by "facts and figures." In the case we have been considering the results are not absurd, it is true; but they are certainly exaggerated. We cannot accept Dr. Stark's conclusion that "bachelorhood is *more destructive to life than the most unwholesome trade, or than residence in an unhealthy house or district where there has never been the most distant attempt at sanitary improvements of any kind.*" But we *may* accept his opinion that "statistics have proved the truth of one of the first natural laws revealed to man,—It is not good that man should live alone." Whether the law required any proof is a question into which we need not enter; our readers must form their own conclusion on this point.

THE UNIVERSE OF SUNS.

By Richard A. Proctor.

(*Continued from page* 26.)

MICHELL did not enumerate any complete theory respecting the universe or even respecting the galaxy. We have seen how skilfully he discussed the observed laws of stellar distribution. His inquiries into this subject naturally led him into speculation respecting the arrangement of the star system into systems or groups; but he did not extend these considerations beyond those parts of the sidereal heavens which he regarded as probably nearest to us. He indeed mentions the nebulæ, but not so particularly as to determine their position in the scheme of creation.

The most important of Michell's theories is that which relates to the existence of laws of arrangement (even among the stars visible to the unaided eye), according to which the stars form systems, separated from each other by relatively vacant spaces. "We may conclude," he says, "that the stars are really collected together in clusters in some places, where they form a kind of system, whilst in others there are either few or none of them, to whatever cause this may be owing, whether to their mutual gravitation, or to some other law or appointment of the Creator." He then proceeds to inquire whether the sun "likewise makes one of some system." He considers that this is probably the case, and it is in endeavouring to separate those stars which probably belong to the same system as the sun from those which do not, that he has occasion to speak of the nebulæ. "There are some marks," he says, "by which we may with great probability include some and exclude others, while the rest remain more doubtful. Those stars which are found in clusters and surrounded with many others at a small distance from them belong probably to other systems and not to ours. And those stars which are surrounded with nebulæ, are probably only very great stars which upon account of their superior magnitude are singly visible, whilst the others, which compose the remaining parts of the same system are so small as to escape our sight. And those nebulæ in which we can discern either none or only a few stars, even with the assistance of the best telescopes, are probably systems which are still more distant than the rest." On the other hand, he infers that those stars "which being placed at a greater distance from each other compose the larger constellations, and such as have few or no smaller stars near them when examined with telescopes, belong probably to our own system." Variable stars, also, he regards as in all probability members of the system of stars to which our sun belongs. He does not assign a reason for this opinion, but from the place in which it appears we may infer that he regarded the changes of brightness among such stars as due to changes of distance, a cause which would necessarily be more effective in the case of stars relatively near to us. He judged that red stars are in reality much larger than we should infer from their brightness; "many of them also have been observed to have a proper motion of their own, which with several other concurrent circumstances tends to make it highly probable that they are some of the nearest to us," and therefore belong to our own system.

Michell makes some very interesting remarks on the probable appearance of the particular star-cluster to which our sun belongs, as supposed to be seen from the Pleiades. He considers two hypotheses respecting the extent of this cluster. According to one the cluster contains about 1,000 suns, according to the other about 350. He considers also two hypotheses respecting the relation which our sun-cluster bears to the Pleiades—making the mean distances between sun and sun in the two clusters equal in one theory, and the mean magnitudes equal in the other. We need not follow him in his reasoning on these considerations. Let it suffice to mention that adopting one set of considerations he infers that our cluster would subtend about two degrees as seen from the Pleiades, with no star bright enough to be seen by the naked eye and only about ten in a two-inch telescope; while if the other be adopted our cluster would subtend about twelve degrees as seen from the Pleiades, some ten stars would be visible to the naked eye, and all the stars down to the fourth magnitude belonging to the cluster would be seen in a telescope two inches in aperture.

It will be noticed that although Michell formed no definite theory of the Milky Way, his ideas respecting the stars spread over the celestial sphere imply a theory of the stellar system (including the Milky Way) somewhat resembling Lambert's. For Michell clearly understood that the stars are gathered into definite aggregations which are separated from each other by vacant or comparatively vacant spaces; and doubtless his opinion respecting the Milky Way was that that zone consists of a congeries of such aggregations, lying at different distances, but foreshortened so as to resemble a connected stream or series of streams. Michell's ideas differed from those of Lambert, however, in this respect, that Michell did not regard the different systems of stars composing the complete sidereal system, as either regular in shape, or similar to each other in figure, dimensions, or constitution. He judged rather from observed facts, and attentive reasoning thereon, than from preconceived opinions as to the uniformity of creation. In this respect he appears to me to have had the advantage of all who had preceded him in theorising respecting the universe. His views also appear altogether more worthy of attention than the theories commonly ascribed to the Herschels in our text-books of astronomy. Regarded as theorisers respecting the sidereal universe, the Herschels deserve the pre-eminence assigned to them, but not for the reasons commonly assigned. If Sir W. Herschel, in particular, had in reality maintained even to the close of his career as an observer, the theory of the universe commonly associated with his name, I believe that we should have to

assign a far higher place to Michell than to Herschel as well for acumen in interpreting observed facts as for skill in combining such facts into a consistent theory.*

(To be continued.)

GREEK FIRE.

AT what period the ancient Greek fire was invented has never been certainly determined. There are many writers who place the invention in a far antiquity. Historical details have been adduced pointing to the period of the earlier wars between the Greeks and Romans as the true era of the discovery. But we do not find any certain evidence of the use of Greek fire until the sieges of Constantinople, in the seventh and eighth centuries, though a Father of the Christian Church, writing in the fifth century, gave receipts for making a combustible substance of similar qualities from the compounds resin, sulphur, pitch, pigeon's dung, turpentine, and the juice of the herb "all-heal."

It is related that the true Greek fire was invented by a certain Callinicus, an architect of Heliopolis, in Syria (Baalbec), in 678. The secret of the composition of this artificial flame, and the art of directing its action, were imparted by Callinicus—who had deserted from the Caliph—to the Emperor of Constantinople. From this period until the year 1291 the use of Greek fire was an important element in the military power of the Byzantine empire. The progress of the Saracens was, more than once, decisively checked by the destructive action of this powerful and terrible flame. The important art of compounding the fire "was preserved at Constantinople," says Gibbon, "as the palladium of the state: the galleys and artillery might occasionally be lent to the allies of Rome; but the composition of the Greek fire was concealed with the most zealous scruple, and the terror of the enemy was increased and prolonged by their ignorance and surprise."

The accounts which have reached us respecting the properties of the Greek fire are such as to justify the high value attached by the Byzantine emperors to the secret of its composition. It was a liquid, which was propelled by various methods against the ships or engines of the enemy. So long as it was kept from the air, or remained in large masses, the liquid appears to have been perfectly safe from combustion; but as soon as it was poured forth it burned with an intense flame which consumed everything around—not merely burning upwards, but with equal fury downwards and laterally. Water not only failed to quench it, but made it burn with new ardour. To subdue the flames it was necessary to employ, in large quantities, either sand or vinegar. Various methods were employed for propelling the liquid fire towards the enemy. Sometimes it was enclosed in vessels made of some brittle substance, and these were flung at the enemy by means of suitable projectile machines. "It was either," says Gibbon, "poured from the rampart in large boilers, or launched in red-hot balls of stone and iron, or darted in arrows and javelins, twisted round with flax and tow, which had deeply imbibed the inflammable oil." But the effectual use of the destructive compound seems to have been best secured by means of a species of fire-ships specially constructed for the purpose. Copper and iron machines were placed in the forepart of these ships. Long tubes, fantastically shaped, so as to resemble the mouth and jaws of savage animals, formed the outlet for a stream of liquid fire, which the engine—literally a fire-engine—propelled to a great distance. Hand-engines were also constructed by which the destructive compound could be spurted by the soldiers, Beckman tells us.

The secret, as we have said, was carefully kept by the Byzantines. The emperor Constantine suggested the answers which in his opinion were best fitted to elude the pertinacious questioning of the barbarians. "They should be told that the mystery of the Greek fire had been revealed by an angel to the first and greatest of the Constantines, with the sacred injunction that this gift of Heaven—this peculiar blessing of the Romans—should never be communicated to any foreign nation; that the prince and subject were alike bound to religious silence under the temporal and spiritual penalties of treason and sacrilege; and that the infamous attempt would provoke the sudden and supernatural vengeance of the God of the Christians." Gibbon adds that the secret thus religiously guarded was "confined for above 400 years to the Romans of the east; and at the end of the eleventh century the Pisans, to whom every sea and every art were familiar, suffered the effects without understanding the composition of Greek fire."

This, however, is not wholly true. The secret was preserved, indeed, from the Romans of the west, but the Saracens managed to possess themselves of it very much earlier than Gibbon's account would imply. For, at the siege of Thessalonica, in the year 904, the Saracens—we are told by John Comeniata—threw liquid fire, by means of tubes, upon the wooden defences of the besieged, and by this means principally succeeded in capturing the town.

In the Holy Wars the Mahometans freely availed themselves of the use of Greek fire. Gallant knights, who feared little the swords or lances of the Saracen host, were terrified by the uncouth aspect and the hideous noises of machines which belched forth upon them a torrent of liquid fire. Joinville tells us that "it came flying through the air like a winged long-tailed dragon, about the thickness of an hogshead, with the report of thunder and the velocity of lightning; and the darkness of the night was dispelled by this deadly illumination."

It does not by any means follow, because the invention of gunpowder rendered the ancient Greek fire no longer a very useful military weapon, that the knowledge of the secret of its composition would be of little value. We must remember that the use of firearms rendered the old-fashioned engines, by means of which the liquid was propelled, no longer available, since those who worked the engines could no longer venture near enough to the enemy. It was to this cause, we suspect, rather than to any want of efficiency in the compound itself, that the discontinuance of the use of Greek fire should be ascribed. The time had not yet come for making gunpowder itself a useful adjunct to the employment of liquid flame.

It is not so clear, however, that the ancient Greek fire was much more efficient than that which has recently come into use. Still, the inquiry into the nature of its composition is not without interest.

The Princess Anna Comnena states that Greek fire was compounded of sulphur, resin, and oil. It may be well to dwell on this point, since many writers have been disposed to consider naphtha, or liquid bitumen, to have been the principal ingredient of the Greek fire. Possibly, however, the oil mentioned by Anna Comnena may have been naphtha, and not, as one would be disposed to infer, any of the ordinary vegetable or mineral oils; for the use of naphtha in lamps is of great antiquity.

Gibbon writes:—"Naphtha was mingled, I know not in

* Of course I make no reference here to Sir W. Herschel's fame as an observer, which would remain unaffected whatever opinion we might form respecting his theories of the universe.

what proportions, with sulphur and with the pitch that is extracted from evergreen firs—that is, resin—in forming Greek fire."

It is a moot point whether Friar Bacon ever discovered the true composition of the liquid fire. Many supposed that he concealed a real ignorance on the subject, when he supplied an apparently unmeaning answer to the questions addressed to him. Others, however, assert that two of the components of Greek fire were, as Bacon said, sulphur and saltpetre, and that the third is to be detected in the logogriph—"Luru vopo vir Can utriet." We leave this anagram to the ingenuity of our readers, mentioning, in passing, that it contains the apropos words "urit voraciter," but that the extraction of these words leaves us only the combination "lupovun" from which it will not be found easy to form a word. Possibly there is a mistake in transcription to add to the anagrammatic difficulty.

Many others have tried to elucidate the question. Friar Bungay, Charles du Frêne, Ducange, and Joinville—a host, in fact, of commentators, historians, and antiquarians—have all had something to say more or less to the purpose. But the satisfactory solution of the problem has not yet been obtained, nor, perhaps, is it likely to be.

It has been well remarked by a writer on the subject, that "gunpowder blew the ancient Greek fire out of the field." But, during the American War of 1860-65, it was shown that gunpowder might be used to blow modern Greek fire into cities. Whether the example will ever become a recognised military precedent is uncertain. But it has been shown that Greek fire may be flung into a city by means of a suitably prepared shell, and that its destructive properties may thus be made available when the besieging force is four miles or more from the central parts of the city. Charleston was certainly not destroyed by General Gilmore's fire-shells; in fact, there are difficulties connected with the construction of such shells, which, though far from being insuperable, were not wholly mastered by the artillerists under Gilmore. But that an immense amount of damage was effected is shown by the fact that General Beauregard hurled from the mouth of his cannon denunciations against Gilmore for employing "the most villanous compound ever used in war."

That Greek fire will one day be employed as a fearfully destructive agent in warfare seems scarcely probable. Yet, so far from looking forward with dismay to the prospect of such an application of its properties, we may rather, perhaps, consider that prospect as favourable to the interests of peace. We may apply to this case the remarks applied by Fuller to the use of cannon:—"Though some may say that the finding of such appliances hath been the losing of many men's lives, yet will it appear that wars are now fought with more expedition, and that victory standeth not so long a neuter, before she express herself on one side or other."

A course of six lectures on "Primitive Man" will be delivered by Sydney B. J. Skertchley, Esq., F G.S., M.A.I., on successive Tuesday evenings, commencing Jan. 22. With a view to extending the advantages of these lectures to working-men and women, the committee have decided to issue tickets, admitting to the gallery, at one shilling for the course, or threepence to any single lecture, and they request the assistance of secretaries of working men's clubs and trade organisations in making these lectures known amongst their members. Tickets may be obtained of any member of the Lecture Committee, at the Institute, on the evenings of the lectures, or upon application by post to the honorary secretary, Conrad Thies, 76, Graham-road, Hackney, E.

HOW TO MAKE USEFUL STAR MAPS.

By Richard A. Proctor.

(*Continued from page* 6.)

THE plan described in our last is the mathematical plan. The plan I always adopt is less scientific, but easier and far more accurate.

Having obtained the lines K N and L M (Fig. 2), with the division-points along them,* as at first, I place a piece of

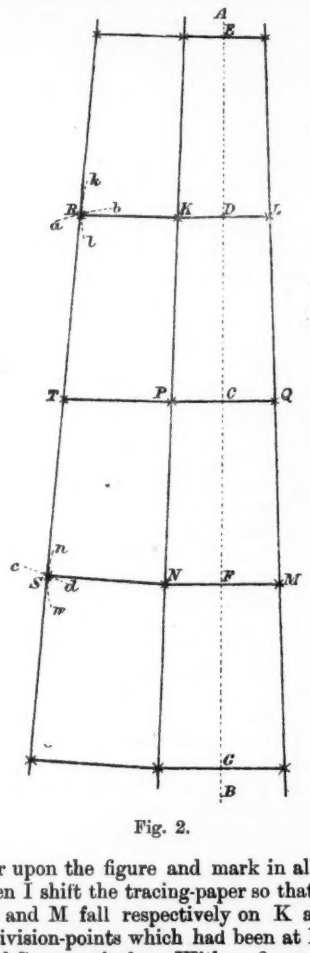


Fig. 2.

tracing-paper upon the figure and mark in all the division points. Then I shift the tracing-paper so that the division points at L and M fall respectively on K and L, and of course the division-points which had been at K and L now fall on R and S respectively. With a fine pointer I mark the five points along this line, *through* the tracing-paper. Then shifting the latter so that the points originally at L and M fall on R and S, I repeat the process. Lastly, I do the same on the right-hand side of A B, and the points wanted are thus obtained with the utmost ease and certainty.

The meridians being straight, nothing need be said about the way of drawing them in. The parallels are parts of circles, and when the meridians corresponding to K N and L M intersect at a convenient distance, the point of intersection is to be used as the centre of these circles. But

* It will have been noticed that K L and N M (not their *halves* as stated at foot of p. 6) are equal respectively to fifty and sixty-four hundredths of D C. Also, obviously K L corresponds to 50°, not 40°

commonly this is not the case. When this is so, one may either simply join R K, K L, &c., with straight lines, or if the scale of the maps is so large that this has an unsatisfactory look, the plan indicated in Fig. 3 may be followed.

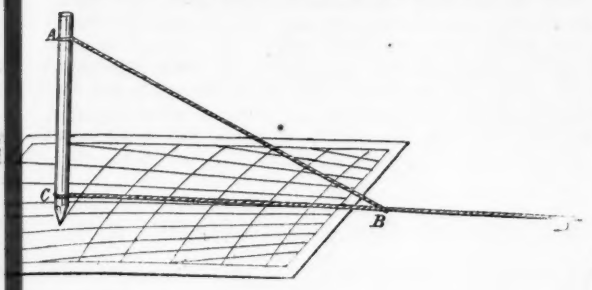


Fig. 3.

This plan ought to be given in every treatise on mapping, but I have never seen it. It is quite general, and I have repeatedly found it exceedingly useful.

Suppose A, B, C, and D to be points on a curved line, and we wish to represent the curved line more accurately than by joining A B, B C, &c. :—Place the edge of a ruler across B so as to fall equally distant (the eye being sufficient judge) from A and C, as at *a* and *c*. With the ruler thus placed draw the line *b' b''*, so that B *b'* may be about one-fourth of A B. Do the line at C. At A put the ruler so that B *b* may be about equal to A *a*, and draw *a' a''*. Similarly draw *d' d''*. Then join *a'' b'*, *b'' c'*, *c'' d'*, and the curved line will be represented *four times* as accurately as by joining A B, B C, &c.

Notice also that all the lines thus drawn are tangents to the true curve, and by a very simple contrivance we can (if necessary) increase the accuracy of the construction yet again *fourfold*. Suppose *c'' d'*, one of the connecting lines mentioned in the above description, *e* its middle point. Then if we join the middle point of C *c''* with the middle point of *c'' e* (the eye being in all such cases quite sufficient judge), and do the like at every corner of our polygonal line, we shall obtain a construction sixteen times as accurate as that given by simply joining A B, B C, &c.

Where the scale of a map is large these methods of approximation are very important. It need hardly be said that all should be done in pencil first.

But the following plan for describing circular arcs of large section is commonly the best for the kind of maps I have been describing above, in which the parallels are circles :—

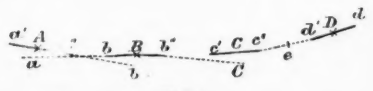


Fig. 4.

The figure (Fig. 4) explains the plan so clearly that there is little occasion for verbal description. The object of the plan is to secure fixity of position for a pencil attached to an inelastic string. The parts A B, B C are in one piece, a knot being tied at B, so that when the parts A and C are slipped to their places on the pencil (where a notch should be cut) A C B may be a right angle. To the knot the cord B D is attached. The pencil must be held so that the cords A B, B C may both be stretched; the centre for the points of the parallel, which are already marked in, is easily found by trial; then the string is there held down by the thumb-nail while the upright pencil is carried round the parallel.

I have found this method very handy and accurate for all large-scale maps. Of course a pen may be substituted for the pencil, but I commonly use the pencil only as a guide for inking in the circular arcs I may be drawing.

Having completed the meridians and parallels of his large-scale chart, the student can have no difficulty in filling in the stars, either from his small-scale atlas or from any catalogue he may possess. I use the British Association Catalogue, which contains many stars not visible to the naked eye. But such a catalogue as that in my "Handbook of the Stars"—in which all the stars from the British Association Catalogue down to the fifth magnitude inclusive are collected in constellations—will be found sufficient for nearly all practical purposes. In fact I originally drew up that catalogue and had it long by me in MS. for mapping purposes. In mapping from a chart it is necessary to notice that the figure of a space on the chart may differ altogether from the true figure of the corresponding space in Fig. 1. In the maps by the Society for the Diffusion of Useful Knowledge, for instance, the angles of the spaces often differ very much from right angles. In this case, when marking in the stars from such a space, the mappist must remember to estimate the distance of each star parallel to the sides of the space in which it appears. He must, in fact, conceive two lines drawn through the star, parallel to the sides of the enclosing space, and notice in what proportion these lines are divided by the star. In the corresponding space in his map the star must divide the corresponding lines in a similar proportion.

The mappist will find it convenient to have a simple way of indicating star-magnitude. I know of none better than the following :—

Stars of the 1st, 2nd, 3rd, 4th, and 5th magnitudes by eight-pointed, six-pointed, five-pointed, four-pointed, and three-pointed figures respectively, with ray-lines between the points; stars of the 6th magnitude by a tiny cross, with fine lines between the rays.

THE MORALITY OF HAPPINESS.

By THOMAS FOSTER.

(*Continued from page* 255, *Vol. IV.*)

SELF *VERSUS* OTHERS.

WE teach our children, the preacher tells his flock, but few follow the precept,—Care more for others than for self. It sounds a harsh doctrine to say, instead,—Each must care for himself before others. Yet it is not only true teaching, it is a self-evident truth. It would not be even worth saying, so obviously true is it, were it not that in putting aside the doctrine because of its seeming harshness men overlook or try to overlook the important consequences which follow from it.

If a man's whole soul—nay, let me speak for a moment in my proper person—if my whole soul were filled with the thought that my one chief business in life is to make those around me, as far as I can make my influence felt, as happy as possible, to increase in every possible way the stock of human (nay, also of animal) happiness, I must still begin by taking care of myself. For if through want of care I myself should cease to exist, I can no longer in any way serve others; nay, it is even conceivable that my immature disappearance from the scene of my proposed exertions for others' benefit might cause some diminution of the totality of happiness.

If the very thought of care for self should suggest that there can be no real love or care for others where self-care

comes first (self-evident though the proposition be that care of self *must* come first), let us replace the case rejected as imaginary, by a concrete and familiar illustration.

None can question the unselfishness of the love which a mother feels for her infant babe. None can doubt that if question arose between the babe's life and her's, her own life would be willingly sacrificed. Of course there are exceptions,—perhaps many,—but no one can doubt, and multitudes of cases have proved, that the rule holds generally. Now the nursing mother not only has, in her very love for her babe, to take care of herself, but to care for herself *first*, and to take more care of herself than, but for her pure, unselfish love for her child, she would have troubled herself to take.

Let this case suffice to show that care of self before others (not therefore necessarily more than others) besides being a self-evident duty (which many may regard as a mere trifle), may be not only perfectly consistent with regard for others and even with devotion to others, but may be absolutely essential to the proper discharge of our duties towards others. In fact, it is little more than a truism (instead of being, as many would at a first view imagine, a paradox), that the more earnest our wish to increase the happiness of others, the more carefully must we look after our own welfare.

If we take a wider view, and instead of considering a single life study the development of families and races, we still find the same lesson. As the man who wishes his life to be useful to his fellows and to increase their happiness must take care of that life, so he who would wish to benefit humanity through his family or race, must not only nourish his own life and strength, but must develop those activities which advance his own welfare and the welfare of his family. Otherwise come inevitably the dwindling of the faculties on which his own value depends, and the loss in his descendants of good qualities which they might otherwise have inherited from him. Or it may be that such qualities are inherited in less degree than had he duly exercised powers and capacities which were in a sense held in trust for them. We are apt to overlook the importance of individual action in such cases, not noticing that the progress of a race depends on the aggregate of acts by the individual members of the race.

To take a concrete instance here, as of the simpler case, —If a number of persons in any nation or at any epoch, impelled by a desire to benefit their fellows, devote their lives to celibacy, they influence in important degree the qualities of the next and succeeding generations. They diminish the proportion in which their personal qualities—presumably valuable—will appear in future generations, and relatively increase the proportion of other and less desirable qualities. This is obvious enough. It should, however, be almost as clear, that in whatever degree such persons in a community as possess the best qualities, fail to advance, in all things just, their personal interests, they diminish the influence of the better qualities, not only in their own time, but in times to come. If—to take another concrete example—all persons of the better sort, forgetting their duties to themselves and their race, enter of set purpose on lives of poverty, asceticism, and dreariness, they not only diminish in large degree the good they might do during life, but they injure their offspring, and, through them, posterity.*

Under its biological aspect then the doctrine that care of self must necessarily take precedence of care and thought for others, is incontestible—it is the merest truism—though many speak, and some act, as if the doctrine were iniquitous.

But this doctrine has its moral aspect also. The question of duty comes in at once and very obviously so soon as the actual consequences of conduct have been shown to be good or bad. But it may be well to show more definitely what the true line of duty is in regard to self. I shall therefore next consider cases where self-abnegation leads directly to the diminution of general happiness.

(To be continued.)

* Many would probably be startled if a just estimate could be formed of the degree in which the qualities of the civilised races of the world have suffered through the well-meant but mistaken zeal which led large classes of men in former ages to sacrifice their *power* to do good in *order* to do good.

CAUSES OF THE GLACIAL PERIOD.

WHEN we endeavoured to briefly summarise the "Evidences" of the Glacial Period, it was our privilege in every instance to have to do with facts; when, however, we come to inquire into the "causes" of that period, we enter, to a greater or less extent, the field of speculation and theory. Nevertheless, such inquiry is of interest and importance, because it incidentally enables us to assign a more or less probable date and duration of time to the Glacial Period, which are of great use in furthering our calculations concerning other questions, such as the antiquity of man, &c.

Before proceeding with our inquiry, I may premise that some of the animal remains found in the glacial deposits and in caves would lead us to infer that intervals of mitigated severity occurred during the Glacial Period. For example, in England, besides the remains of the mammoth, hairy rhinoceros, reindeer, and other Arctic animals, are also found remains of the hippopotamus, lion, and hyæna, these latter animals being not at all Arctic in character. Now these animals, not being able to endure severe cold, must either have been only summer visitors during the severity of the Glacial Period, or else they must have been permanent residents in our country during mild intervals of the same period; and as we do not know many instances of large animals performing summer migrations like birds, the latter alternative offers the best explanation of their occurrence. I mention these facts here because in our investigation of causes it will be useful to bear them in mind, and to remember that any cause or causes which would explain such mild intervals of climate during the Glacial Period would also explain the presence of these animal remains.

Now, the Glacial Period was in all probability not due to one cause alone, but rather to a combination of many causes, both astronomical and geographical. We will consider first the more probable astronomical causes:—

1. *The Excentricity of the Earth's Orbit*, to the explanation of which term I now proceed. The earth moves round the sun, not in an exact circle, but in a somewhat egg-shaped or elliptical path called its orbit. But this orbit is not at all periods the same in shape. Sometimes it is more elongated; at other times it more nearly approaches the form of a circle. When the orbit is elongated, it is said to have a great excentricity; when nearer the circular form, it is said to have a small excentricity, these variations in the shape of the orbit being due to the unequal attraction exerted upon the earth by the other planets of the solar system, especially Jupiter and Saturn. Thus, when at that part of its orbit most distant from the sun, the earth is much farther away from that body during great excentricity than during small. Consequently, any part of the earth having its winter when the earth was farthest distant from the sun during great excen-

tricity would, no doubt, have comparatively a very severe climate, and this may have been one cause of the Glacial Period. At the present time, the excentricity of the earth's orbit is very small,* the difference between the earth's distance from the sun at its nearest and farthest points being only *three* million miles; whereas, during times of great excentricity that difference may amount to *thirteen* million miles. By mathematical calculations based upon the known attraction exercised upon the earth by the other planets, and the known position and movements of these planets, it is calculated that a period of great excentricity would occur, to a greater or less degree, between 210,000 and 100,000 years before the present time. Therefore, in all probability, it was during that time that the Glacial Period occurred.

2. At the present time, however, the winter in the northern hemisphere occurs when the earth is *nearest to* the sun, or, as it is called, in *perihelion*; the effect of such nearness to the sun being nevertheless more than counteracted by the shortness of the days during the winter season, due to our hemisphere being then turned away from the sun. But there is a movement known as the *precession of the equinoxes*, caused by the attraction of the sun and moon upon the protuberant portion of the earth at and near the equator, whereby the direction of the pole is made very slowly to describe a circle in the heavens causing the equinoxes, and with them the other seasons, to come round a very little sooner than they otherwise would. And there is another movement known as the *revolution of the apsides* (the apsides being the points in the orbits nearest to and farthest from the sun) caused, like excentricity, by the attraction upon the earth of the other planets, whereby these apsides, or points in the orbit are constantly changing their places. These two changes combined cause the seasons to occur successively in every part of the earth's orbit, so that sometimes the winter of the northern hemisphere has occurred and will occur again when the earth is *farthest from* the sun; or, as it is called, in *aphelion*. Now, if this state of things occurs when the excentricity of the orbit is small, its effect upon climate is probably not very great; but when it coincides with a period of great excentricity, important results may be the consequence. For, as the earth must of necessity move more slowly the farther it is from the sun, it will be obvious that during such periods of coincidence not only would the winters be more severe, but they would also be longer in duration, and consequently large masses of snow and ice would accumulate which the short summers would be unable to melt. These short, warm summers would engender fogs, phenomena which all Arctic travellers have experienced, and these fogs would cut off the rays of the sun from melting the ice. The snow also, by reflecting a great part of the sun's rays, and the ice, by absorbing the same before it could be thawed, would prevent a large portion of those rays from ever reaching the earth's surface at all. Moreover, a cold condition of the northern hemisphere generally would probably induce a change in the winds and currents of the globe (the currents, of course, being chiefly dependent upon the winds), and instead of southerly winds and currents which have traversed tropical regions, warming our atmosphere as at present (when an opposite state of things prevails, the southern hemisphere being now the colder) there would probably be a greater number of winds and currents flowing down from the icy north to the less cold south, and these would leave the cold north colder still. So that we see all these things tend to show us that the northern winter occurring in aphelion during a period of great excentricity would be very favourable to the occurrence of a Glacial Period in our part of the world.

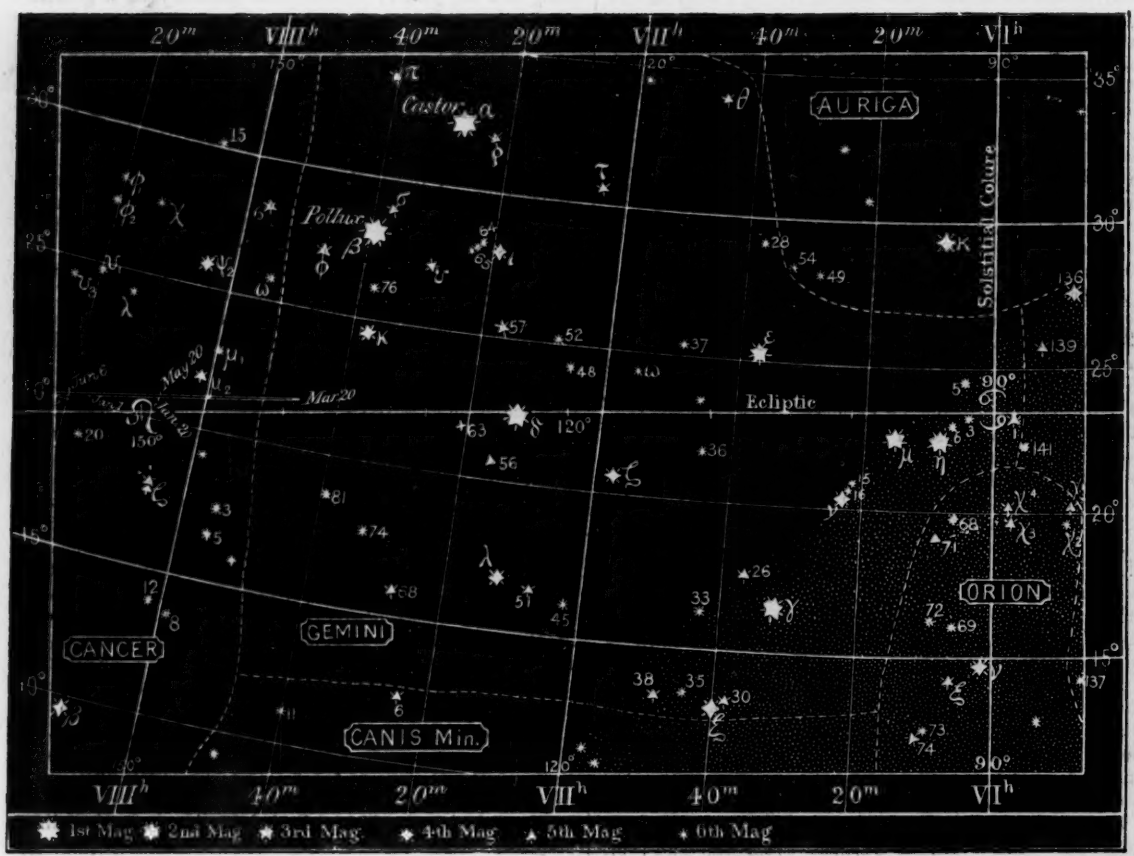
But here an interesting part of the problem presents itself to our notice. I have said that owing to two movements of the earth, known as the precession of the equinoxes and the revolution of the apsides, the seasons are brought about successively in every part of the earth's orbit. The time taken for this cycle to be completed is 21,000 years. During that period of time the seasons will have occurred at every part of the orbit; once, therefore, they will have occurred in perihelion, and once in aphelion. I have also said that a period of great excentricity is shown by calculation to have extended, to a greater or less degree, from 210,000 years to 100,000 years before the present time, that is, for a duration of 110,000 years. Now if the cycle of 21,000 years be divided into this period of 110,000 years, we shall find it will go five times, that is to say, that during the supposed duration of the Glacial Period five times would the northern winter occur in perihelion and five times in aphelion. Thus, as it is obvious that the winters occurring in and near perihelion must have been milder than those occurring in and near aphelion, we should have during the 110,000 years, the supposed duration of the Glacial Period, five somewhat lengthy periods of comparative mildness when the northern winter occurred at and near perihelion. Now we have seen that the remains of certain animals found in glacial deposits, such as the hippopotamus, lion, &c., indicate a mild climate, while those of others, such as the mammoth, reindeer, &c., indicate a cold one. May not these different climates have occurred during the Glacial Period at times corresponding respectively to the northern winter in and near perihelion, and the northern winter in and near aphelion? At any rate, I think this explanation more probable than that the differences of climate were due to the elevation and depression of land during the Glacial Period, a supposition we shall treat of more fully when we come to consider the geographical causes. There is just one other thing that I should like to mention before leaving these astronomical causes. The experience of many arctic travellers has shown us that no condition of things can be more favourable to a Glacial Period than a short, hot summer and a long, cold winter. We have seen that these are just the conditions most likely to obtain under a period of great excentricity, while the fluctuations in climate caused by the different positions of the earth during such period goes far to explain the singular fact of the great variety of animal remains found together in England and elsewhere, and the milder intervals in climate which some of these remains indicate. The name of "Interglacial Periods" has been given to these mild intervals in the climate.

In our next article we shall proceed to consider the geographical causes, and some less probable astronomical causes which have been alleged by some as playing a part in bringing about the great Glacial Period.

ROBERT B. COOK.

* See the figure illustrating the article on "The Earth's Path Round the Sun." It should be noticed that the departure of the earth's orbit from the circular *form*,—or what is called the *ellipticity*,—is very slight even when the *excentricity* is at its greatest. This will be illustrated later in a picture showing the earth's orbit when most excentric.

COPPER FROM ARIZONA.—Last year Arizona produced seventeen million pounds of copper. Thus far, during the present year, the increase has been 38 per cent., and new furnaces are being erected. The output from Arizona for the year 1883 will probably be not less than 25,000,000 lb.



Zodiacal Star-Map for January (showing Jupiter's Path).

ZODIACAL MAP FOR JANUARY.

By Richard A. Proctor.

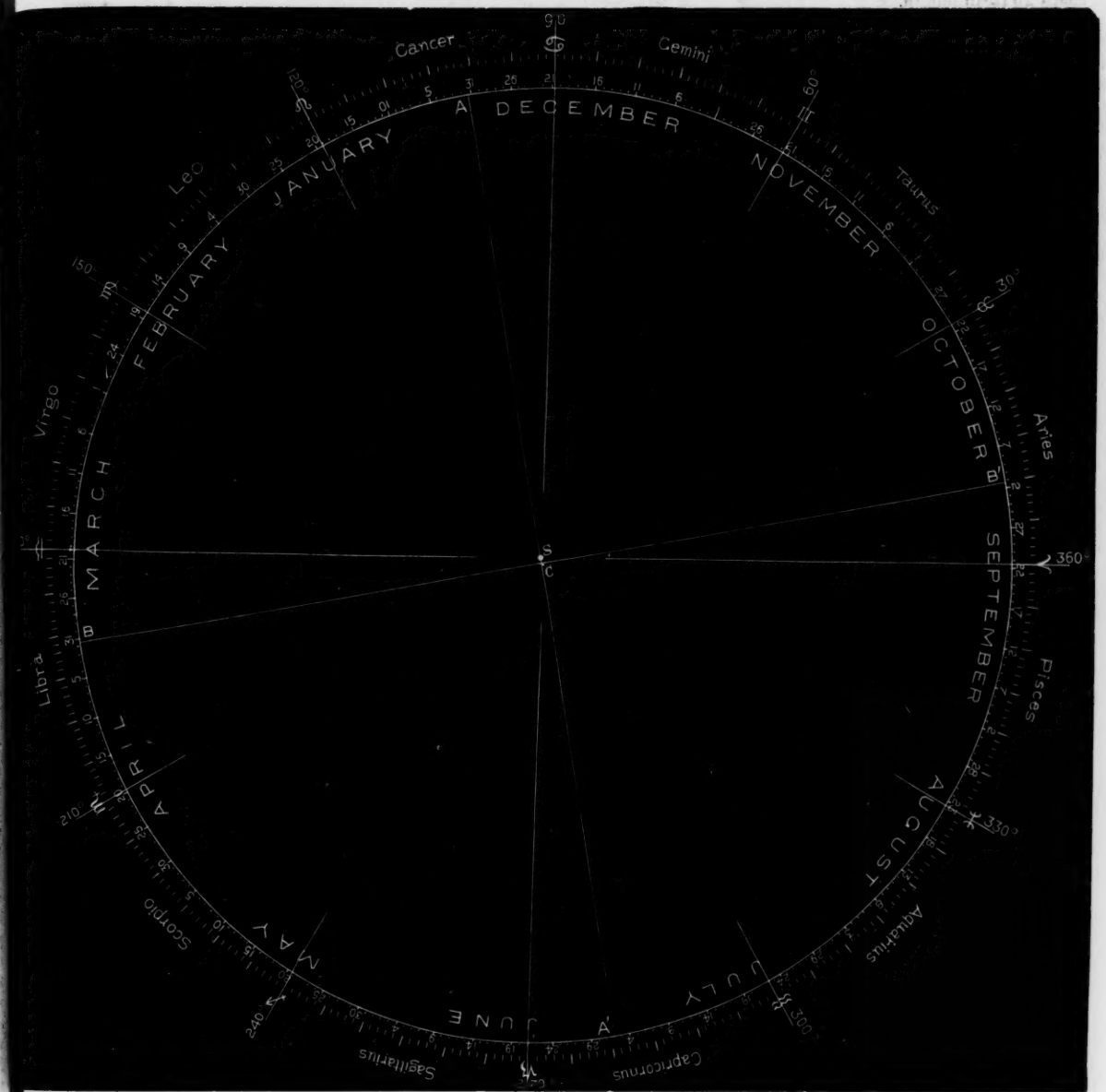
THIS week we give the Zodiacal Star Map for January. It needs no explanation. The path of Jupiter is given, and will appear again in the next map, for these zodiacal maps overlap some five or six degrees. Albeit the path of Jupiter is not shown with any idea of helping even the youngest student of astronomy to identify that resplendent planet. Rather will the observed position of Jupiter serve to guide the student to recognise the stars shown in these two zodiacal maps. (In the next, which will appear next week if room can possibly be found for it, the path of Mars also will be shown.)

I may note, however, that although the zodiacal map which appears this week is the first of the dark or black-ground series, yet as I am not satisfied with the effect, where the meridians and declination parallels appear in full, all the remaining maps of the series will show only the intersections of the meridians and parallels, so that the star groups may appear more clearly. This one will therefore be repeated in due course (that is as the last of the series), with that change made.

In the white zodiacal maps the meridians and parallels will be shown in full, and also the sun's course from day to day throughout the year in the order corresponding with the positions of the earth from day to day in her orbit as shown this week.

The movements of the planets in their orbits will be shown in pictures to appear shortly, in such sort that the exact positions of all the planets in any day during the next year or two can be seen at a glance. But the fact is that there is a difficulty in making room for all the astronomical illustrations which the movements of sun, moon, planets, &c., really require from month to month.

Britain's Future.—It savours of the sensational to assert that there are causes in operation which, if they continue to act unchecked, will in the course of time produce not merely the downfall but the absolute destruction and obliteration of Great Britain. Yet such an assertion expresses the literal truth. Observing in passing that "there is much virtue in your if," and that "the course of time" is a somewhat vague generalisation, we may state that not only has the above opinion been expressed by the most eminent scientific men, by such authorities as Sir Charles Lyell and Sir John Herschel, but it does not admit of doubt or uncertainty. Britannia, though doubtless "the pride of the ocean," is being quietly but remorselessly absorbed by the sea-waves. The process is one which—unless hastened by unforeseen but possible changes—must take many ages. It is also a process which may be, and probably has often been, interfered with in a summary manner. But no doubt whatever can exist that the process is now in steady operation, and that its effects are far from being insignificant.



THE EARTH'S PATH ROUND THE SUN.

WE give this week a picture, exactly drawn to scale, of the earth's motion from day to day in her orbit around the sun. We suppose her to start from 0° longitude at noon on March 20, and show her position at noon on successive days from that time till the next March 20, when she is still one quarter of a day's motion from the position whence she started. The study of this diagram will be found useful in considering the explanation of the Almanac running through KNOWLEDGE for this present year 1884; but it has also other uses. We shall have occasion to refer to the diagram many times during the next few months, and perhaps years.

We propose to give in a few weeks, for comparison with the path here shown, the more eccentric orbit of the earth 850,000 years ago, when the orbit had attained very nearly the greatest degree of eccentricity possible.

THE MIGRATIONS OF BIRDS.

AT the bottom of what we call our "lower gardens" we have a large, disused, double coach-house, in which wood is stored. The doors of this coach-house are always left standing open in both summer and winter, in order to give free access and ingress to "all sorts and conditions" of wild birds which may care to build or shelter there. A massive beam supports the ceiling of this coach-house in-

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side; the beam is fully 1 ft. 2 in. square as to girth, and perhaps 20 ft. in length.

About twelve years ago a pair of swallows discovered that the inner side of this beam offered an "eligible building site," and they accordingly built a nest in the snug angle formed at one end by the beam, the wall, and the ceiling. We should never have discovered the nest, except from seeing the birds flying in and out of the doorway; for, being *behind* the beam, it was quite invisible to any one who did not go into the farther end of the coach-house, and then turn round to look up at the inner side of the beam.

When the next summer came, our swallows returned to the old nest, bringing with them another pair, who built at the other end of the same beam, also on the inner side. And now, every year, two or more pairs arrive with the regularity of winter tourists returning to their English homes for the summer months.

I venture to think that this fact may be accepted as positive evidence that the same birds, or their young, return each year to the same nests. The place is so secret, so hidden from sight, even from the doorway, and, in all respects, so out-of-the-way, that no mere stranger would be likely to discover it. I conclude that the first pair of swallows did discover it, by pure accident; but it was an accident not likely to happen again. It had certainly never happened before, during all the years that we have lived here. Once discovered, it has never been forgotten; and when each successive summer brings our busy and beautiful visitors we please ourselves with the thought that, if not the identical swallows of twelve years ago, they are undoubtedly the descendants of our first lodgers.

I beg to offer this observation by way of a pendant to Mr. Grant Allen's interesting paper on the "Migrations of Birds," in your number for Jan. 4.

Amelia B. Edwards.

Our Portrait.—"We" remember hearing Emerson say that none of his portraits that he had yet seen did full justice to the combined grace and dignity of the original. It is so with ourself. When we—but this editorial "we" is a nuisance—when I was in America, as also when I was in Australasia, several portraits of me appeared which gave me entirely new ideas about my personal appearance. If they had agreed either among themselves, or with my photographs, or with what my friends saw in me, I might have inferred that I was simply seeing myself as others saw me. But they did not. In some I looked preternaturally truculent, in others as portentously amiable; while others showed all sorts of varieties between those limits. In this country, during the past twelve months four presentations, all intended however as caricatures, have appeared:—One in *Vanity Fair* last spring, with which the artist was not content, there I look rather dictatorial and more positive than I feel; another in *Figaro* (Dec. 7) where I look too sweet for any use; another in the Christmas number of *Truth* where I look peppery (I suppose at least it is I scowling over Lord R. Churchill); and lastly one in the current number of the capital new weekly *Our Boys*, where I find myself looking very happy and contented, but rather more leary than I supposed. The paragraph relating to me states that I am a very clever man, and know it. Am I? and Do I? I should like to know: but I am not likely to. I learn that I was a famous athlete in my youth, which surprises me almost as much as the statement in *Vanity Fair* that I was once a great equestrian. The account of my life in *Figaro* is as near the truth I think as it could be made.

THE BÜRGIN DYNAMO-ELECTRIC MACHINE.

(Concluded.)

THE field magnets, to which a brief reference was made in the previous article (Knowledge, No. 113), are of massive proportions, and cast-iron is used as in other machines, on the score of economy and because their polarity does not change in quality or kind. The resistance of the wire on the field magnets of the machine illustrated, which is constructed to feed the powerful arc lamps, is 1·2 ohms, the resistance of the armature being 1·6 ohms, making a total internal resistance of 2·8 ohms.

The wire on the field magnets is connected to separate terminals, and is, therefore, capable of being used in a circuit distinct from the armature, the object of this arrangement being to afford facilities for imparting larger currents to the illuminating or external circuit. When this is done a smaller *exciting* dynamo, with its armature current passing round its own field magnet, in the usual manner is used to supply the necessary current to the field-magnets of the larger machine. The armature being thus separated from the field or inducing magnets, a material reduction in the resistance of the external circuit is effected, and a proportionately larger current produced. It is evident that this feature is of enhanced importance in incandescent lighting, because of the extremely low resistance of the purely external or lamp portion of the circuit.

In comparing the Bürgin with the gramme we observed that there is a considerable deviation in the construction of the armature, which consists of a number of rings rigidly fixed to a revolving spindle (Fig. 3). In the Gramme ring the current generated in one sectional coil of wire is connected to the next succeeding coil; but M. Bürgin allows the current produced in the first section of the first ring to be transmitted through the second section of the second ring, thence through the third section of the third ring, and so on. In this way the current traverses what is practically a complete ring, and so compares with the Gramme.

A remarkable feature about the machine is the proportionately small quantity of copper-wire used, and the increase in the proportion of iron employed. By this means a more intense magnetic field is produced, which is truly traversed by a smaller quantity of wire, the reduction in the wire being compensated by the increased intensity of the field. Iron is furthermore considerably cheaper than copper, and much less liability to heating and to opposing induction is experienced. On the occasion of a visit we made to the "Arc Works," Chelmsford, where the machines are manufactured, we were much struck by the relative coolness of the machines, in the attainment of which the above feature is not the least important factor. They run at speeds ranging from 900 to 2,000 revolutions per minute; to do which the armature, being a heavy one, must be, as indeed it is, very carefully and accurately balanced. With a No. 4 machine, weighing 8½ cwt., running at 800 revolutions per minute, a current having an electro-motive force of 150 volts is produced, the current through a circuit of three Crompton arc lamps being sufficient to yield a luminosity of about 3,000 candles in each arc. The works referred to are probably the largest of the kind in the kingdom. Certain it is, however, that Messrs. Crompton & Co. have for some time been enjoying a very large share of what business has been transacted in the electric-light world. The adaptability of the Bürgin dynamo contributes to this in no small measure. When made in larger proportions it is capable of sustaining a great number of lamps, and for incandescent lighting a

machine is constructed to produce sufficient current to illuminate five hundred Swan lamps. The weight of such a machine is about 70 cwt., and its speed 900 revolutions per minute.

Mr. Crompton invariably uses Swan lamps for incandescent lighting, because he finds, as he and others anticipated, that a greater illuminating power per horse-power could be produced with Swan than with either of the other forms. He finds that he can actually obtain three hundred candle power per horse-power, or twelve Swan lamps at the full power of twenty-five candles each. This is largely in excess of the work accomplished by other systems.

The dynamo may be wound on the shunt principle, that is to say, instead of the whole of the current passing from the armature through the field magnets, only a portion is allowed so to travel, the remainder being sent through the external circuit. In this way the current, as it emerges from the armature, has two courses open to it, and will divide between them inversely as their resistances, so that if by any means the resistance of the external circuit is increased a larger proportion of the current passes through the inducing coils and produces a more intense magnetic field, and a stronger current is consequently produced in the armature. Conversely, should the resistance of the external circuit be diminished, a smaller proportion of the current will pass through the coils of the inducing magnets, and a less intense magnetic field is produced, with the result that feebler currents are produced in the armature. Thus, if an ordinarily wound dynamo were sustaining, say, four arc lamps, and another lamp were inserted, the resistance of the circuit, including the lamps, armature, and inducing coils, would be increased by the amount of resistance in the added lamp and its arc. The result would be that the current would be lessened, and consequently the inducing or field-magnets would have less effect on the armature, and a further reduction in the strength of the current ensues. Thus, there is not only insufficient current for the five lamps, but actually less current than when only four lamps were in the circuit. On the other hand, if one of the four lamps were cut out of the circuit, the total resistance would be diminished, and a stronger current would circulate through the inducing magnets, &c., resulting in a further increase in the current produced in the armature, but obviously less current suffices to light three lamps than is required for four lamps. In experiments made upon two similar machines, one worked on the shunt system and the other with the whole of the wire and the lamps in one circuit, the superiority of the shunt for producing a steady current and yielding automatically to variations in the condition of the external circuit was fully maintained.

The Crompton-Bürgin Compound Machine, designed for incandescent lighting, is an advance upon the shunt system. The current, on emerging from the armature, divides into two circuits—one composed of comparatively fine wire, and forming the coils for exciting the field-magnets; the other comprising, in addition to the lamps and leads, a few turns of thick wire, also wound on the field-magnets. The automatic controlling effect exerted by this arrangement is obvious from what has been said anent the simple shunt-system. It must be remembered that every lamp added to the circuit in the usual manner—that is, in multiple arc—decreases the external resistance, because an additional channel is offered for the transmission of the current. Consequently, a smaller proportion of the current will pass through the thin coils, and if left alone to influence the field-magnets, the intensity of the field would be diminished; but the increased current circulating in the thick coils compensates for the loss in the thin coils, and so maintains the luminosity of the lamps. So readily do the coils respond to any change in the circuit, that if nearly the whole of the lamps were cut out, those remaining would continue to yield a steady light, no change being perceptible.

The system introduced by Mr. Crompton has been in commercial use for about four years, and during that time it has been installed in a large number of public buildings, including the Royal Courts of Justice and the Mansion House, London; the Town Hall, Birmingham; the Post Office, Glasgow; and several of the larger railway stations, in addition to several large ocean-going passenger steamers. Taking all things into consideration, we may safely say that no man has done more to make the electric light practicable than Mr. Crompton.

A THEORY OF VISIONS.*

A CAMBRIDGE student had arranged, some years ago, with a fellow-student that they should meet together in Cambridge at a certain time for the purpose of reading. A short time before going up to keep his appointment my informant was in the South of England. Waking in the night he saw, as he imagined, his friend sitting at the foot of his bed. He was surprised by the sight, the more so as his friend was dripping with water; he spoke, but the apparition, for so it seems to have been, only shook its head and disappeared. This appearance of the absent friend occurred twice during the night. Information was soon received that, shortly before the time of the apparition being seen by the young student, his friend had been drowned while bathing.

This story has the typical features of a whole class. The essential characteristic is the recognition, after physical dissolution, of a deceased person, by one who has known him in his lifetime, in the form which distinguished him while a member of the living human family.

Now let me pass from the spiritual to the physical, and endeavour to expound some notions concerning real vision and supposed vision of objects, which may be useful in helping us to form something like a *rationale* of such apparitions as those of which I have been speaking.

When an object is placed before the eye, the light emanating from each point of the object falls upon the eye, and having passed through the several lenses and humours of which the eye is composed, is made to converge upon a point in the screen or retina which constitutes the hinder portion of the eye; and so a picture is formed upon the retina, much in the same way as in the photographer's camera-obscura. In fact, the eye may be described with some advantage, and without much error, as being a living camera-obscura. The retina is in reality the expanded extremity of the optic nerve, which communicates with the brain; our object, therefore, by means of the machinery of the eye, is placed in immediate communication with the brain; every wave of light from each point of the object produces a vibration on the retina, and so presumably on the brain. After this our physical investigation comes to an end—the vibrations of light from our visible object are lost in mystery. It is no exaggeration to say that we know nothing more than men knew centuries ago. A man says, "I see a ship;" and he tells the truth, but *how* he sees it neither he nor any one else can tell. You track the ship to its picture on the retina, but there you must leave

* From a paper by the Bishop of Carlisle (Dr. Harvey Goodwin) in the *Contemporary Review* for January.

it: even if you say that you can connect it with the brain, you have still an infinite gap between the impression on the brain, and the result expressed by the words "I see."

The fact is, that in vision we have a demonstrable transition from the physical to the spiritual; how the transition takes place it baffles our intellect and our imagination even to guess, but that there is such a transition no one can doubt.

This being so, is it not at least conceivable that, as the object moves the visual machinery of the eye, and this machinery moves the mind, so if the mind be directly moved (supposing for a moment that this is possible), the result may be the movement of the visual machinery, or at all events the production of the impression that it has been so moved?

To illustrate my meaning, take the case of the ringing of a bell. The pulling of the bell-rope causes the bell to give forth a sound; if you hear that sound, you conclude that the rope has been pulled; and if the bell should, in reality, have been rung by some one who had immediate access to it, you would still, in default of other knowledge, conclude, though erroneously, that the sound arose from the pulling of the rope.

Now let it be supposed, for argument's sake, that the mind can be acted upon otherwise than through the senses. The senses, as we all know, are the ordinary avenues to the mind, especially the two highest of the senses—namely, seeing and hearing; still it does not seem unreasonable to suppose that there may be other avenues. If man has a spiritual nature which is embodied in a fleshly tenement—which is at least a reasonable supposition, and corresponds almost to a human instinct—and if there be spiritual beings which are not so embodied, then it would seem not unreasonable to suppose that those spiritual beings should be able to hold converse with the spiritual part of men without the use of those avenues which the senses supply, and which are the only means whereby one material being can communicate with another.

Let us go a step further. Is it not conceivable that the spiritual part of man, "set free from the burden of the flesh," may (under conditions which we, of course, are not in a position to determine) have communication with the spiritual part of another man who still lives in the body? I do not at all say that we could anticipate by the power of reason that this would be so; but I can see nothing unreasonable in supposing it possible, and if phenomena should be in favour of the hypothesis, I think the hypothesis could not be set aside by any *à priori* considerations.

But if this be so, we arrive at a case similar to that of the bell being rung without any pull upon the rope. In other words, may it not be that a communication made directly by one spirit to another may *seem* to arise from that action of the senses to which mental impressions are usually due? I lose a friend, and that friend is able (I know not how or why) to communicate with me; his spirit makes itself known to my spirit; I become conscious of his presence by a direct, though inexplicable, spiritual action; what more probable than the supposition that this direct communication will *seem* to have been made through the senses? In fact, as being myself subject to the laws of sense, could I be conscious of my friend's presence in any other way than by imagining that I saw his form or that I heard his voice?

To take the case, the particulars of which I have already related. If we suppose that the student who was drowned was able to hold, at the moment after his decease by drowning, some kind of spiritual communication with his friend in Cambridge, is it not conceivable that the spiritual communication would transform itself into a brain action by the reverse of the process according to which brain action normally transforms itself into a spiritual communication, and that so the effect would be the production of a persuasion in the mind of the student in Cambridge that he actually saw with his eyes his absent friend?

The *rationale* of apparitions which has been suggested will, perhaps, receive confirmation from the consideration, that instances occur in which the full sense of vision is produced by the brain itself, without any suspicion of what may be called preternatural agency. The following story was related to me some years ago in the presence of one of the persons to whom the event described happened, and who vouched for its truth:—

A lady with a family of young children was occupying a house in Cheltenham, while the husband and father was absent on business in Scotland. Looking out of the windows of a back drawing-room upon a small garden, which communicated by a door with a back lane, several of the children saw the garden-door open and their father walk through and come towards the house. They were surprised, because they were not expecting their father's return; but uttering a shout of joy, several of the party ran downstairs there to find, to their disappointment and sorrow, that no father had arrived. So strong was the illusion that when the father did return, a week or more afterwards, he was reproached for having played some trick, of which he was perfectly innocent. I ought to add that the curious illusion which has been described had no consequences of any kind—good, bad, or indifferent; no one died, no one was taken ill, no family event of any sort took place; the whole thing was an illusion, and nothing more. It is, however, curious, as having been shared by several persons. The member of the family, whom I knew, and in whose presence I heard the story, assured me that she never saw anything in her life more distinct than her father seemed to her to be, and that her sisters had said the same.

An Expensive Railway.—Seven tunnels, of a total length of seven miles, will be built on the line of the Harrisburgh and Western Railway (U.S.A), between Harrisburgh and the Youghiogeny River. This portion of line will cost about £40,000 per mile. It is to be completed in two years.

Importance of Trifles in Science.—Few circumstances in the history of scientific progress are more remarkable than the way in which apparently insignificant facts suddenly acquire an unexpected importance. A physicist examines with interest a few dark lines which he detects in the solar spectrum, and by degrees the peculiarity attracts attention among scientific inquirers; yet the very labourers in the new field of research would have heard with amazement that the lines they were examining were one day to become the means of teaching us how to analyse the central luminary of our system. Again, inquisitive men examined the phenomena of electricity, and accumulated a number of seemingly unimportant facts; yet the days were to come when results which appeared to be mere matters of curiosity were to bear more largely on the interests of men and nations than any perhaps which have ever rewarded the inquiries of scientific men. The steam-engine itself, which alone vies with the electric telegraph in the importance of its influence on the well-being of mankind, resulted from inquiries suggested by the insignificant movements of a common saucepan-lid. In the history of astronomy we are presented with many illustrations of the kind here referred to.

Reviews.

AMONG THE INDIANS OF GUIANA.*

BY EDWARD CLODD.

THIS is as solid and withal as attractive a book of travel as it has been our fortune to read for many a day. Its interest is not dependent upon the adventures which make up so many "travellers' tales," for of adventures, in any exciting sense, there are none. It is not the outcome of a rapid scamper across a wide continent, neither is it a hotch-potch of information gathered at second-hand and served up with trimmings from the "Encyclopædia Britannica." The author has spent in all four years among the fellow-subjects of ours whom he describes, and his sound and scholarly book has slowly built itself up from materials which he has personally gathered, and which in the end come to us in their now related, shapely, and charming force.

The earlier and less important chapters of the work are devoted to a rapid sketch of the physical features of the regions explored, and of the journeys from the coast into the interior—necessarily taken, in the absence of any roads thither, along the larger rivers. The country consists of four distinctly-marked tracts, lying one beyond the other, parallel to the coast-line. The sugar-tract, which is the only cultivated portion, lies nearest the seaboard. Behind this is the timber tract, which yields important and abundant supplies; then the forest tract, lying too remote for profitable carriage of its valuable wood; and last of all is the savannah, or wide-reaching grass-plain, which spreads over so large an area of South America.

Mr. im Thurn's sketch of the physical geography of British Guiana might with advantage have been supplemented by a sketch of its geology. The rich alluvial *detritus* of this shoulder of the South American continent is the gift of its noble rivers, and of more recent origin than the mountain ridges intersecting the savannahs, and probably marking the ancient coast-line of the Atlantic Ocean; whilst evidence points to the former existence of a large inland lake, from the mist of whose shrunken waters was born that legendary capital of the fabled land of El Dorado which kindled the ardour of Raleigh. Strolling to the brow of the hill on which Quatata stands, Mr. im Thurn describes how—

> "In the far distance the plain was bounded by the ridges of the Pacaraima mountains, which were at that moment much hidden by dense white clouds. Gradually the masses of these clouds rose, and only a long, rugged, and broken line of vague white mist remained, marking where the mountains rose from the plain. Presently the sun began to shine with power, and lighted up each jutting fantastic point of this low-lying mist, until the whole seemed a city of temples and towers, crowned with gilded spires and minarets."

In his description of the scenery the author's remarks are usefully supplemental to, although not always in agreement with, those made by Mr. Alfred Wallace, in his well-known essay on "Tropical Nature." Both are corrective of current misconceptions as to the brilliant blaze of colour in the flowers and birds which is thought to be a universal feature in the tropics. Speaking of plants, Mr. im Thurn says: "The spread of the colour-fallacy is due to the fact that it is the more gorgeous plants which, being selected from an infinitely greater number of less brilliant hue, are grouped together in our glass-houses." The general colour of the forest is due rather to the various shades of the leaves, than to any wide scattering of flowers, and at no season is the Guiana leafage as splendid as is an ordinary English wood, either in the early spring or in the autumn time. The difference of effect lies not so much in the colour of flowers in temperate and tropical zones as in their distribution; in the latter the blossoms are more evenly scattered throughout the year, while in the former they are more seasonal. But the sweet odour of the tropical trees, with their plumes, and globes, and flame-like spikes of dazzling flowers, would be a poor exchange for the flowers that carpet our meadows, for the rich undergrowth of our copses, and for the mosses that nestle round our forest trees.

Whilst Mr. im Thurn's love for "the larger and more free ways of Nature" makes him wax eloquent in attempt to dispel the prejudices of the dweller in temperate climes against tropical discomforts, he candidly piles up the agony in an appalling list of the ills to which man is subject in hot countries, chiefly from creatures whose power to irritate seems in inverse proportion to their size. Taking only a sample or two from the long catalogue, when one reads of bats, from whose painless bite such loss of blood may ensue as to prove fatal; of black "*kaboori* flies," more dreaded than mosquitoes; of jiggers, that bury themselves under the soft skin between the nails and the fingers or toes, and deposit their eggs to be thus hatched under one's skin, vermin, of which, despite every care, twenty-three squatted on, or rather in, Mr. im Thurn in one day, we may count over our list of British pests with complacence. In his visit to the Kaieteur Fall, formed by the rush of a tributary of the Essequibo over an abrupt cliff of 741 feet, Mr. im Thurn was fortunate enough to discover both a new plant and a new bird, the latter, *Agelæus imthurni*, being very properly named after him by Mr. Sclater; and, apart from this addition to the naturalist's knowledge, he will find the chapters on the fauna and flora of Guiana a storehouse of information.

But we must turn to that part of his book in which, as its sub-title indicates, the author (and with him the present reviewer) has the keenest interest, namely, that dealing with the four or five semi-barbarous tribes, for they have practically passed out of the stone-using stage, mostly of Carib stock, scattered over the forest tract and the savannahs. The rivers of the colony are, as already stated, the high roads to the interior, and the tributaries are the cross-roads. It was up the largest of the four chief rivers, the Essequibo, that Mr. im Thurn and his companions made their way, taking steam to the confines of civilisation, when they embarked in canoes with the natives whom they had engaged. Wherever they stayed they found the Indians hospitable and civil, and free in their offers of casiri, a drink prepared from the cassava plant, and tasting "like something between sour porter and thin claret." But it is a delectable liquor compared to the horrible stuff called paiwari, of which "etiquette demands that the visitor should finish it to the last dregs." It is made from burnt fragments of cassava bread, which, after being mixed with water, are picked out and chewed by the women while moving about their usual household work, the fragments being replaced in the water, which is boiled and then allowed to ferment, the result being a liquor looking like coffee with plenty of milk in it. Some of the tribes prepare paiwari by boiling only; but, in the judgment of native connoisseurs, the flavour is very inferior to that secured by the "orthodox chewing process." "One day passes very like another to the traveller as he ascends the river in his canoe," Mr. im Thurn remarks. For hundreds of miles only three or four settlements were passed. Each day brought the same sounds from the same dense forests

* "Among the Indians of Guiana"; being sketches, chiefly Anthropologic, from the interior of British Guiana. By Everard im Thurn, M.A., Oxon. (London: Kegan Paul, Trench, & Co. 1883.

growing down to the river banks and clothing the mountain ranges, from the summit of which one may look down

"on the great and wide sea of tree-tops, ending only at the circle of the horizon, and unbroken except where here and there a long, narrow thread of white mist marks the winding course of some small stream."

The Indians were more alert by night than by day, telling endless tales as they lay smoking in their hammocks, over which lumps of meat hung close to their mouths for economy of time in wakeful moments. Their capacity for gorging was measured by Mr. im Thurn. In thirty-six hours ten men consumed "252 lb. of smoked fish, 62 lb. of fresh fish, a whole wild hog, and an indefinite quantity of cassava bread." But the monotony of the journey was varied by misfortunes, all which were referred by the Indians to the paiman or medicine-man, or to Mr. im Thurm's presumption in actually touching an erratic boulder, which no Indian looks at if he can help it!

At last the limits of the canoe voyage were reached, and the explorers glad to make their home for a time in one of the largest settlements, consisting of a few mud-walled and palm-thatched houses, in one of which they held their levées for barter with the Indians. The information as to their social customs and beliefs gathered by Mr. im Thurn is of sufficient importance to demand separate notice.

(*To be continued.*)

THE FACE OF THE SKY.

From January 18 to February 1.

By F.R.A.S.

As fine groups of spots continue to appear on the solar disc, the sun should be examined with the telescope whenever the sky is clear. The night sky is pictured in Map I. of "The Stars in their Seasons." Mercury is still, for the observer's purpose, invisible. As Venus does not set for between two and three hours after the sun at the end of the month, she may be caught with the naked eye in the twilight over the western horizon. She continues perceptibly gibbous in the telescope. Mars comes into opposition to the sun at 11 a.m. on February 1st, so that he is now as favourably placed as he will be during his present opposition. His angular diameter slowly increases from 16″ to 16·6″ during the next fortnight, and the amount of detail now visible on his surface renders him a most interesting object for the telescopic observer. His green seas, red land, and white polar snow, albeit distributed in a widely different fashion on his surface to that in which their terrestrial analogues are on that of our own globe, seem to give him a kinship to the earth which is not apparent in any other of the planets. Jupiter comes into opposition to the sun at 3 a.m. on the 20th, and is now as well placed for the observer as he possibly can be. His equatorial diameter subtending an angle of some 43″, he is now a truly noble object, even in a small telescope; and every increase of optical power reveals fresh wonders and beauties in his complicated system of belts and markings, with their fine distinctions of colours, and in the varying phenomena exhibited by his satellites as they pursue their respective paths round their giant primary. Of such phenomena, visible before 1 a.m. during the next fourteen days, the following are the chief:—To-night (the 18th) the shadow of Satellite II. will enter into Jupiter's limb at 10h. 35m., followed by Satellite II. itself at 10h. 38m. Neither the satellite nor its shadow will quit the planet's face until between one and two a.m. to-morrow. Satellite III. will reappear from occultation at 8h. 1m. p.m. on the 19th. On the 20th, Satellite II. will be occulted by Jupiter at 5h. 41m. p.m., reappearing at his opposite limb at 8h. 35m. p.m. On the 22nd, Satellite IV. will enter on the face of the planet at 11h. 8m. p.m., followed by its shadow at 11h. 53m. The student should by all means observe this transit, if possible, for the reason given more than once in these notes, viz., that very curious appearances indeed have been witnessed by observers during the transits of Jupiter's outer satellites. At 12h. 23m. on the same night Satellite I. will begin its transit, as will its shadow at 12h. 28m. The egress of these satellites respectively and of their shadows will not occur until two or three hours after midnight. On the 23rd Satellite I. will be occulted at 9h. 30m., and, after passing behind the body of the planet and through its shadow, will reappear from eclipse at 11h. 53m. 2s. p.m. On the night of the 24th Satellite I. will begin its transit at 6h. 49m., as will its shadow at 6h. 56m. The satellite will leave Jupiter's face at 9h. 9m., and be followed by its shadow at 9h. 16m. The same Satellite I. will on the succeeding evening (that of the 25th) reappear from eclipse at 6h. 21m. 35s., and the transit of Satellite II. begin 52m. after midnight. On the 26th Satellite III. will be occulted at 7h. 41m. p.m., to reappear from eclipse at 11h. 53m. 6s. Satellite II. will be occulted by Jupiter at 7h. 55m., on the 27th, to reappear subsequently from eclipse on the opposite side of the planet at 11h. 10m. 33s. Satellite I. will be occulted at 11h. 14m. on the night of the 30th. On the 31st Satellite I. will enter on to Jupiter's disc at 8h. 33m. p.m., followed by its shadow at 8h. 51m. The satellite will leave the opposite limb of the planet at 10h. 53m., its shadow at 11h. 11m. p.m. Lastly, on the night of Feb. 1, Satellite I. will be occulted at 5h. 40m.; to reappear from eclipse at 8h. 16m. 4s. Saturn continues to present an object of the highest interest to the observer, and may be well seen up to midnight. His ring system continues sensibly unchanged; but, as he is receding from the earth, his angular diameter slowly diminishes. He continues to travel backwards through the sky, in that part of it to the west of ε Tauri ("The Stars in their Seasons," Map I.). Our remarks on p. 13, with reference to Uranus and Neptune are equally applicable during the ensuing fortnight. Pons' comet has now travelled down into the southern hemisphere, to be observed, let us trust, under clearer skies than have prevailed in these latitudes during its apparition. The moon is 20 days old at noon to-day (the 18th), and will, of course, be 29 days old at the same hour on the 27th. Then at noon, on the 23rd, her age will be 0·3 day; and, quite obviously, 4·3 days on Feb. 1. The only occultation which will occur before 1 a.m. during the next fourteeen days is one of the sixth magnitude star, 21 Piscium, which will disappear at the moon's dark limb on the 31st, at 7h. 49m. p.m., at an angle of 162° from the moon's vertex. It will reappear at her bright limb at 8.45 p.m., at an angle from her vertex of 314°. The moon is in Virgo to-day, and will continue to travel through that constellation until 6 p.m. on Sunday, the 20th, when she will pass into Libra. She will not emerge from Libra until 8 p.m. on the 22nd, at which hour she will cross the boundary into Scorpio. She will take ten hours to traverse the narrow northern strip of this constellation, and at 6 a.m., on the 23rd, will enter the southern confines of Ophiuchus. It will be 2 a.m., on the 25th, before she will quit Ophiuchus for Sagittarius, and she will take until 1 p.m., on the 27th, to traverse the last-named constellation. At the hour just named she passes into the north-west corner of Capricornus, crossing it in nineteen hours; and at 8 a.m., on the 28th, enters Aquarius. At midnight, on the 30th, she quits Aquarius for Pisces, where she will still be found at the date of the termination of these notes.

The Telescope and Astronomy.—It is almost impossible to exaggerate the influence which the invention of the telescope has had upon modern astronomy. The mere enlargement of the various objects of interest visible on the celestial vault is the least of the services rendered by the telescope. It is as an aid to the progress of physical astronomy that the instrument derives its chief importance. Not even Newton's gigantic intellect could have established the theory of gravitation without the aid of the telescope; or rather, we should say that without its aid he would not even have attempted to establish the theory which renders his name illustrious. Poor as was the instrument with which Flamsteed pursued his observations at the Royal Observatory in comparison with the telescopes now in use, yet—we have it on Newton's own authority—without its aid Newton's researches into the lunar motions would have been valueless. On those researches, as is well known, the theory of gravitation was established. Since Newton's time telescopic observation has again and again brought forth new evidence of the truth of the great theory, and has again and again led mathematicians to devise new and more powerful modes of analysis, to push their calculations to a greater and greater degree of exactness, and, in fine, to bring their science to that wonderful degree of perfection which has been exemplified by the labours of Adams and Leverrier, Airy, Hansen, and Delaunay.

"Let Knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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PERPETUAL MOTION ON THE LARGE SCALE.

[1092]—In his remarks appended to my letter (No. 1081, p. 29), Mr. Proctor says that my note in the *Gentleman's Magazine* of December last on "Dismal Astronomy," was an attack especially directed against himself. This is a complete mistake, as a careful reading of the note itself will show. The hypothesis I attacked is there described as the one "now in fashion." Had I supposed that Mr. Proctor would have thus interpreted my remarks, I should have been more definite in stating the duration of the fashion, which is many years older than himself. I named no particular astronomer, because a very large majority of the astronomers of the present day follow this fashion. All who accept with the easy confidence—"now in fashion"—the nebular hypothesis of the origin of solar systems are "attacked." [Regret my mistake.—R. P.]

I may be imprudent in thus confronting such a host of high authorities, but am not likely to adopt the feminine device to which Mr. Proctor alludes as a weapon of attack upon anybody, especially on a friend so greatly respected as himself. If ever I should be moved to especially "pitch into" him, it will be on his own ground in KNOWLEDGE, with his own readers to form the ring; and whatever may be the amount of mutual bruising, I have no doubt that we shall shake hands, both before and after the fight like true Englishmen. [Gladly.—R. P.] W. MATTIEU WILLIAMS.

THE AFTERGLOW.

[1093]—In reply to the query of Captain Noble (No. 1078, p. 14) I quote the following from my diary: "Dec. 25, crimson fog; 26th, crimson fog morning and evening, and shown by gas-lights; 27th, crimson fog with drizzle, same as on 25th and 26th. Warm wind S.W. to W." "Shown by gas-lights," refers to the gas-light glow of London, which I see very distinctly across the fields that extend about three miles to S.E., between Stonebridge Park and Kilburn. Formerly this London luminosity was greyish, like the zodiacal light, but since the early part of last summer it has become pink and crimson, the redness increasing gradually and variably up to the present time. It is not only visible on looking towards London from a distance, but may be seen *in* London on misty evenings, by looking along a street that is well lighted, and by looking upwards. This was the case last night (Sunday, Jan. 13), and I have little doubt that it will be visible again many times during this winter.

Jan. 14, 1884. W. MATTIEU WILLIAMS.

THE AFTERGLOW IN CHESHIRE.

[1094]—I see that no one has yet called your attention to the brilliant and extraordinary sunsets in Cheshire, and as they differ somewhat from those already described, I thought you might like to hear about them. Last week, on December 19, 20, and 21, respectively, we had, about 4.30, a strange "light" noticed by everyone, and rather resembling the "magnesians." This, in a few moments, became golden, then of the loveliest mauve ever seen, followed by blue, and lastly blood-red, changing to the deepest crimson, whilst there were clouds in the south-west horizon of inky blackness. The above lasted upwards of an hour, and the sunrise has been the same. We have this phenomenon at present, but not in such intensity as that of last week. What is the cause of it? For all the nine years we have lived in Cheshire, we have never before seen it. I am sorry you are so unwell, but trust you are really going to "rest on your oars," although we shall miss you. With best wishes for many happy new years, F. ADELINE HARKER.

SKY-GLOW.

[1095]—In reply to query of Capt. Noble in last week's number, I spent Christmas Day in North Yorkshire. The day was cloudless, warm, and spring-like; and, in a perfectly clear sky, the depth of tone of afterglow was most marked. Although I have watched this phenomenon for a considerable time, I have never seen such a depth of vivid colour as on the evening in question. Venus was visible through the glow as a sparkling green gem (I presume from contrast).

I should like to ask Captain Noble, or any other reader in KNOWLEDGE, if he has noticed the glow in daylight? On Nov. 27 and Dec. 1. this was very decidedly visible here in Yorkshire.

The long continuance of dull, foggy weather has been a bar to regular observation.

On the evening of Dec. 3 the glow was very extended, and at 5.35 several stars in Ophiuchus were well visible to naked eye in the midst thereof.—I am, sir, yours truly, ALLAN EKERSHAW.

Ilkley, Yorks., Jan. 6, 1884.

SILENT LIGHTNING.—STRANGE SUNSETS IN AUSTRALIA.

[1096]—The following extract from a letter, received by me yesterday from Adelaide, South Australia, may perhaps be of interest with reference to recent correspondence. The communication is dated December 1 last.

"Last Sunday night we had a most extraordinary storm of lightning, with much rain but little thunder. There had been thunder-storms on the three preceding nights, and this formed the climax. I never saw anything like it. All round the sky was lit up with brilliant flashes, which continued at intervals of not more than a second for two hours. The city might have been lit up by the electric light, so tremendous was the lightning. Since then the weather has been beautifully cool.

To-night the sky has been, just after sunset, a most lovely red colour, tinged with purple, as if a gigantic bush fire were on. It has been so frequently for two months, and nobody seems to know the cause of it. CHAS. E. BELL.

THE MIGRATION OF BIRDS.

[1097]—Will you point out to Mr. G. Allen that his explanation of the migration of birds is very well as far as it goes, but can only be applied to large birds which fly high, but *not to small birds* who do not. The water birds and waders travel by night, and that they do not travel by sight is proved by the fact that they use a continual *call* to enable them to keep together.

Owls may see at night, but they do not fly high, nor do finches, flycatchers, and such like. NATURALIST.

CAGE NESTS.

[1098]—I purchased a parrot at the Crystal Palace about eight years ago. Last year, to my surprise, she made a rude nest at the bottom of the cage, and laid three eggs. I thought it might be information to the student of natural history, but perhaps it may be an ordinary occurrence. While I have the pen in my hand it is as well to mention that last spring a hen canary escaped from the breeding-cage, and made a neat nest between two flower-pots in the conservatory. She got her materials from a Berlin wool mat. But what makes it worth mentioning, she chose the brightest colours, and showed a decided predilection for red. —A. J. W.

P.S.—I was in hopes of hearing in your articles on the rotundity of the earth something about a pendulum that demonstrated the movement of the earth. It is about 25 years ago we all went pendulum mad.

LETTERS RECEIVED (SUB-EDITOR.)

E. E. CORDNER. Thanks.—W. H. HUDEY.—H. J. WYKE.—T. H.—F. PODMORE. We do not keep addresses.—C. H. JONES.—P. B. F.—C. CARNS-WILSON.—A. G. WELD.—R. H. P.—J. GROUT.—MARS. G. FLETCHER. Thanks.—MARS. Probably the state of the atmosphere. If you use the telescope in a warm room the peculiarity is sufficiently accounted for. F.R.C.S.—NATURALIST.—JAS. GILLESPIE. Confident in your own mind you are right! and others wrong? Yet we think the earth really moves round the sun.—A. G. WELD. Cannot be electrical.—J. P. B. Many thanks; but no space.—W. H. SHRUBSOLE.—A. C. P. FIRMIN. In *both* cases.—in any position.

ERRATUM.—In middle of second column of p. 12, (No. for January 4) in the sentence beginning "For instance when a planet," &c., the word "centrifugal" should be replaced by the word "centripetal."

Our Whist Column.

BY "FIVE OF CLUBS."

THE following game is from an old number of the *Westminster Paper*, where, however, it was carelessly annotated :—

THE HANDS.

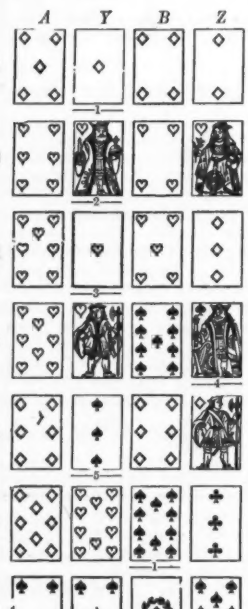
Y.
Spades—6, 5, 3.
Hearts—A, K, Kn, 10, 9, [3, 2.
Clubs—Q, 9.
Diamonds—A.

B.
Spades—A, Kn, 10, 9, 2.
Hearts—5, 4.
Clubs—5, 4.
Diamonds—Q, 9, 6, 4.

Y B
Score—
Four all.
Dealer.
A Z
Trump S. 8.

A.
Spades—Q, 4.
Hearts—8, 7, 6.
Clubs—A, Kn, 10, 2.
Diamonds—K, 8, 7, 5.

Z.
Spades—K, 8, 7.
Hearts—Q.
Clubs—K, 8, 7, 6, 3.
Diamonds—Kn, 10, 3, 2.



NOTES AND INFERENCES.

1. *A* should have led a Club. *Y* has no more Diamonds.

3. *Z* should have discarded a Club. His head sequence was worth guarding.

4. *Y* holds all the remaining Hearts—four.

5. *A* knows that the Q is with *B*; and he can infer almost certainly from *Z*'s discard that *B* holds one more Diamond at least, in which case,

6, Diamond 8 should not have been discarded, but the King; for the King unguarded could only block *B*'s Diamonds. But probably at this stage *A* did not feel sure that he might not want a re-entering card later.

9. *A* should have led his Diamond King before the Club 10. He knows that *Y* has two Clubs and the three long Hearts; that *B* has the long trump and the Diamond Queen. Now it matters not whether *B* has three Clubs, or two Clubs and another Diamond: *A B* must win on the line indicated, making one trick in Diamonds, two in Clubs, and one with the long trump.

10. Here, says the Editor of the *Westminster Papers*, "the game is evidently lost unless *A* discards the Diamond King; this is almost the only point in the game; and yet simple as it is, how many players will persist in keeping such a card; nay more, will scold their partner for throwing it away if it should happen to turn out of no avail." *A*, however, only simplified his partner's play by throwing away the Diamond King. Had he retained it, *B*'s reasoning when about to lead at trick 11 would have run thus :—"We must make all three tricks; a trick in Diamonds is certain; but it is equally certain that unless *A* can make two tricks in Clubs we are lost: he certainly has not both Ace and King, or he would neither have led Diamonds originally nor Club 10 at trick 9; but anyway, if he has these cards, we win; if he has not, we can only win by my leading up to him in Clubs." Therefore *B* would have led a Club, and *A* would have made the three remaining tricks. *A* was right, however, in throwing the Diamond King.

Our Chess Column.

BY MEPHISTO.

KING'S GAMBITS.

1. P to K4. 2. P to KB4.
P to K4.

UNDER this heading come a great number of attacks, in all of which, however, the King's Bishop's Pawn is sacrificed. The capture of the proffered Pawn has the immediate result of favouring White's development, by enabling P to Q4 to be played with advantage, should the Black Bishop venture to QB4, and attacking the advanced Pawn on KB5. Black has to devote his attention to defending this Pawn, which is a somewhat difficult task, as White has a variety of bold and promising continuations at his disposal. If Black succeeds in maintaining his advantage against White's attack—and most authorities agree that the advantage can be maintained—then, of course, Black will emerge from the opening with a better game.

Another course is likewise open to Black, that of declining the Gambit, by not capturing the KBP. We shall first deal with the accepted Gambit, and subsequently revert to the Gambit declined.

After 1. P to K4 / P to K4 2. P to KB4 / P takes P White has two moves at his disposal 3. Kt to KB3, which is the more general move offering an immense variety of interesting combinations, and called the King's Knight's Gambit; or, 3. B to B4, called the Bishop's Gambit. In reply to 3. Kt to KB3, Black's usual defence is 3. P to KKt4, but 3. P to Q4 or 3. Kt to KB3 are also played. We will treat of these moves under the heading of Gambit declined.

In continuation of the attack, White can now play either 4. B to B4 or 4. P to KR4. If 4. B to B4, Black may either choose the normal variation, by playing 4. B to Kt2, or the more vigorous move of 4. P to Kt5, in reply to which White can either play 5. Castles, called the Muzio attack, or 5. Kt to K5, the Salvio attack. Again, in reply to 4. P to KR4, Black's best move is 4. P to Kt5, upon which White has two modes of continuing the attack: by 5. Kt to Kt5, called the Allgaier, or 5. Kt to K5, the Kieseritzky Gambit. The Allgaier Gambit is the more attacking of the two, but entails the sacrifice of the Knight, which Black can force by 5. P to KR3, but the Kieseritzky is more likely to result in an even game. The last attempt in this opening was made by Steinitz against Zukertort, in their encounter at the Vienna tournament, when Zukertort won in twenty-seven moves. After 5. Kt to Kt5, Black need not at once play P to KR3, but may also play P to Q4 which likewise yields a fair game with less risk of attack, to be followed by P to KB3.

We may also mention another popular form of Gambit attack arising out of a variation of the Vienna Opening in 1. P to K4 / P to K4 2. Kt to QB3 / Kt to QB3 3. P to KB4 / P takes P. The difference in the position is that the QKt is already in play. Here Steinitz plays the bold move 4. P to Q4, which is called the Steinitz Gambit, and until lately was considered sound play. If, however, White does not pin his faith to this Gambit he can continue with 4. Kt to B3, upon which Black may reply with 4. P to KKt4, or likewise with 4. B to K2, a move favoured by Bird.

These are the leading Gambit attacks, and although many volumes of analysis have been written regarding these openings, modern research has confined the attack within comparatively narrower limits. We shall explain the attack and defence of the leading variations, and believe that their mastery, combined with ordinary caution, will be sufficient protection to a player against any serious disaster in these difficult openings.

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